Emergence of *Sonchus oleraceus* (common sowthistle) is favoured under zero tillage farming systems

Michael Widderick[1], Brian Sindel[2] and Steve Walker[1]
[1] Queensland Department of Primary Industries, PO Box 2282, Toowoomba, Queensland 4350, Australia
[2] University of New England, Armidale, New South Wales 2351, Australia

Summary The impact of different tillage treatments and seed burial depth on the emergence of *S. oleraceus* was evaluated in two field trials. Increasing soil disturbance reduced *S. oleraceus* emergence and buried a greater proportion of seed below 2 cm than zero tillage or single operation tillage treatments. *S. oleraceus* seed emergence was greatest from depths of 0 and 1 cm, however a small amount emerged from a depth of 2 cm while no seedlings emerged from 5 and 10 cm depths. This study highlights that *S. oleraceus* emergence is favoured in zero tillage systems and that burial of seed through tillage below 2 cm will inhibit emergence of this weed.

Keywords *Sonchus oleraceus*, sowthistle, emergence, tillage, burial.

INTRODUCTION

Sonchus oleraceus (common sowthistle) is a serious weed problem throughout the northern cropping region of eastern Australia. An earlier study (Widderick *et al*. 1999) found that the prevalence of *S. oleraceus* has increased over the last 5 to 10 years and appears to be associated with a move to reduced tillage systems. The shift to conservation tillage has placed a heavy reliance on herbicides for weed management and consequently *S. oleraceus* has developed resistance toward group B herbicides (Adkins *et al*. 1997) and is commonly recognised as a difficult to control weed. As this weed is difficult to control with herbicides, non-chemical weed management options may play an important role in its management.

The effects of tillage and seed burial on *S. oleraceus* emergence were investigated in two experiments to substantiate anecdotal evidence that *S. oleraceus* proliferation is a result of zero tillage farming and to investigate what role tillage may play in managing this weed.

MATERIALS AND METHODS

Seven tillage treatments varying in number of tillage operations and tillage implement used were applied over two years (1999, 2000) during summer fallows. Treatments ranged in intensity from zero tillage with stubble maintained to tillage with three operations using disc and chisel ploughs (Table 1). Emergence was measured during fallow and crop phases, and soil samples were taken prior to wheat planting in 2000 to determine the effect of tillage on *S. oleraceus* seed burial.

The effects of seed burial depth on emergence of *S. oleraceus* was examined by burying seeds at depths of 0, 1, 2, 5 and 10 cm in 25 cm diameter pots containing a black cracking clay soil. Five-hundred seeds per pot were buried in December 1998 and July 1999 and positioned in the ground in a field environment. Emergence was assessed regularly.

RESULTS

Tillage had a profound effect on the emergence of *S. oleraceus*. Emergence was significantly less in plots that had two or three tillage operations than in plots with one or no tillage operations. Emergence was either less or tended to be lower in plots with stubble removed than in those with standing stubble (Table 2).

Table 1. Tillage treatments imposed to assess the effect on *S. oleraceus* emergence and seed burial.

Tillage treatment
Disc + Chisel + Chisel (D+C+C)
Blade + Chisel + Chisel (B+C+C)
Disc + Chisel (D+C)
Blade + Chisel (B+C)
Blade (B)
No tillage with stubble removed (Z-S)
No tillage with stubble maintained (Z+S)

Table 2. Average total emergence (m^{-2}) of *S. oleraceus* under different tillage treatments.

Tillage treatment	1999	2000
Disc+Chisel+Chisel	34.9 a	12.5 a
Blade+Chisel+Chisel	24.4 a	11.1 a
Disc+Chisel	27.2 a	11.6 a
Blade+Chisel	36.9 a	14.6 a
Blade	54.6 b	47.4 b
No tillage–stubble removed	56.9 bc	39.4 b
No tillage–stubble maintained	68.8 c	72.3 c

Means in the same column with different lettering are significantly different at P=0.05.

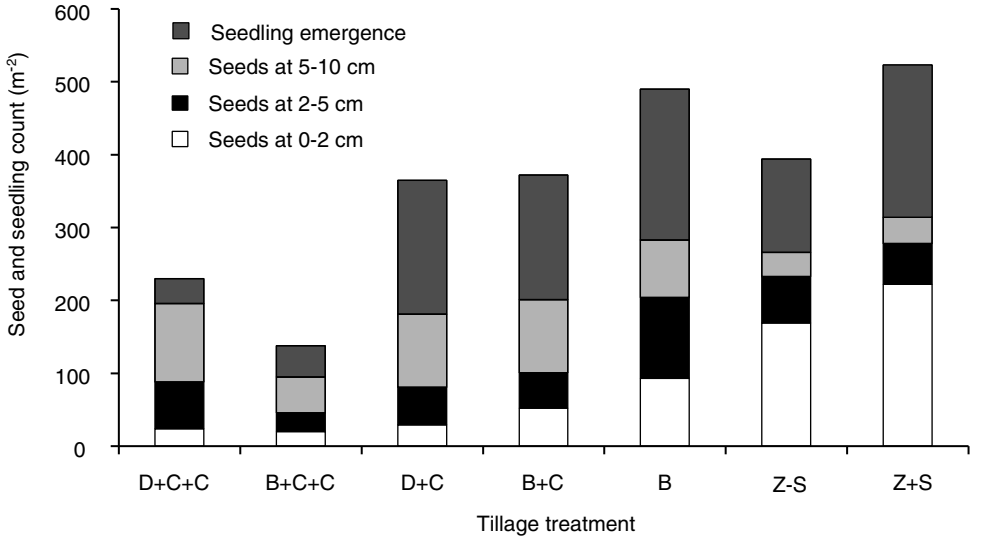

Figure 1. Effect of different tillage regimes on *S. oleraceus* seed burial and emergence (m^{-2}).

Tillage had a substantial effect on the burial of *S. oleraceus* seed in the soil profile. Seed in the top 2 cm of soil decreased from 230 m^{-2} in zero tillage plots to 20 to 50 m^{-2} in plots with two or three tillage operations (Figure 1). The number of seeds at 2–5 cm was approximately 40 m^{-2} irrespective of treatment, apart from the single blade treatment where there was 110 seeds m^{-2} and the blade+chisel treatment where 25 seeds m^{-2} were recovered. Seeds at 5–10 cm increased from 30–35 m^{-2} in zero tillage plots to 80–110 m^{-2} in tilled plots. The exception was the blade+chisel+chisel treatment where only 25 seeds m^{-2} were recovered.

Tillage influenced the total number of seeds recovered as either seedlings or viable seeds. Tillage treatments with three operations had a greatly reduced number of total seeds recovered due to a reduction in seeds in the top 2 cm of soil and reduced emergence (Figure 1).

Depth of seed burial had a significant effect on the emergence of *S. oleraceus*. Emergence was greatest at 0 and 1 cm with 120 and 110 seedlings per pot emerging respectively, in contrast to 15 seedlings per pot emerging from a depth of 2 cm. No emergence took place from 5 or 10 cm. *S. oleraceus* was able to emerge all year round and emerged over the 8 months following planting. After this time no further seedlings emerged as a result of a depleted seed bank.

DISCUSSION

Results from this research show that zero tillage systems lead to a large number of *S. oleraceus* seeds in the top 2 cm of soil. Seed buried above 2 cm were found to readily emerge while burial of seed below 2 cm inhibited emergence. Any system that allows *S. oleraceus* seed to remain on or close to the soil surface, such as zero tillage, will therefore favour its emergence and potential proliferation.

Tillage may play an important role in managing *S. oleraceus* by reducing emergence through a reduction in the number of seeds in the top 2 cm of soil. However, effective management of *S. oleraceus* seedlings for one year under a continuous zero tillage system, will potentially eliminate the seed bank in the top 2 cm of soil, if no seed replenishment takes place.

ACKNOWLEDGMENTS

This project is funded by the Grains Research and Development Corporation.

REFERENCES

Adkins, S.W., Wills, D., Boersma, M., Walker, S.R., Robinson, G., McLeod, R.J. and Einam, J.P. (1997). Weeds resistant to chlorsulfuron and atrazine from the north-east grain region of Australia. *Weed Research* 37, 343-9.

Widderick, M., Sindel, B. and Walker, S. (1999). Distribution, importance and management of *Sonchus oleraceus* (common sowthistle) in the northern cropping region of Australia. Proceedings of the 12th Australian Weeds Conference, p. 198.